FY97 LDRD - HENP Data Analysis: Requirements

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This document describes the detailed computing requirements in this LDRD project that characterize data analysis processes for large high-energy and nuclear physics experiments. These requirements are described in the context of two computing models, one which characterizes a typical event reconstruction scenario and another which characterizes a typical scenario for higher level analysis (so called DST analysis).

Event Reconstruction Scenario

The event reconstruction scenario is illustrated in figure 1. The characteristics of the elements in this scenario are:

- **raw data**
  Event sizes range from 100 KB to 20 MB.
  Number of events used in tests should be in the range 10^3 to 10^6.
- **e.r.**
  Processes that input single raw events and generate single events of derived data (DST).
  CPU requirements are in the neighborhood of 2 Gflops-sec/MB (6 kSPECint92-sec/MB).
  For the purposes of bandwidth testing the cpu cycles used for each event can be adjusted downward in order to reach the desired data rates.
- **DST**
  Events of derived data with sizes approximately 10% of raw event size.
- **e.r. control**
  Coordinates e.r. processes so that each raw event is processed exactly once.

The overall requirements in this scenario are that raw data events are read at an aggregate 20 MB/sec and each event is processed once.

DST Analysis Scenario

The DST analysis scenario is illustrated in figure 2. This scenario is typical of a second stage data analysis of HENP data. At this stage a fraction of the events derived from the original raw events are accessed by any given user for some analysis task. Multiple users accessing possibly overlapping sets of events operate on the system simultaneously. The characteristics of the elements in this scenario are:

- **DST**
  Derived event data.
  Event size read by d.a. processes are 10% of raw event size.
  Event size written by d.a. processes are 1% of raw size.
  Number of events used in tests should be in the range 10^3 to 10^6.
- **d.a.**
  Event analysis process which reads a single derived event and generates a further derived

event which is 10% of the input size.
CPU requirements range from 10 to 10^4 Mflops-sec/MB of the input event[1]

- **d.a. control**
  Process which coordinates the individual d.a. processes to that the correct event sample is processed.

The overall requirements for this scenario are:

- number of simultaneous d.a. control processes (number of users) ranges from 1 to 10
- the system parameters should be analyzed for scaling the number of simultaneous users to 100
- the system parameters affecting aggregate bandwidth for reading DST events should be analyzed for scaling up to the range of 100 MB/sec to 1 GB/sec.
- sample fraction of DST events accessed by a single user range from 1 (100%) to .001 (0.1%).
- The overlap of events accessed by different simultaneous users ranges from 1 (100%) to 0.

Figures

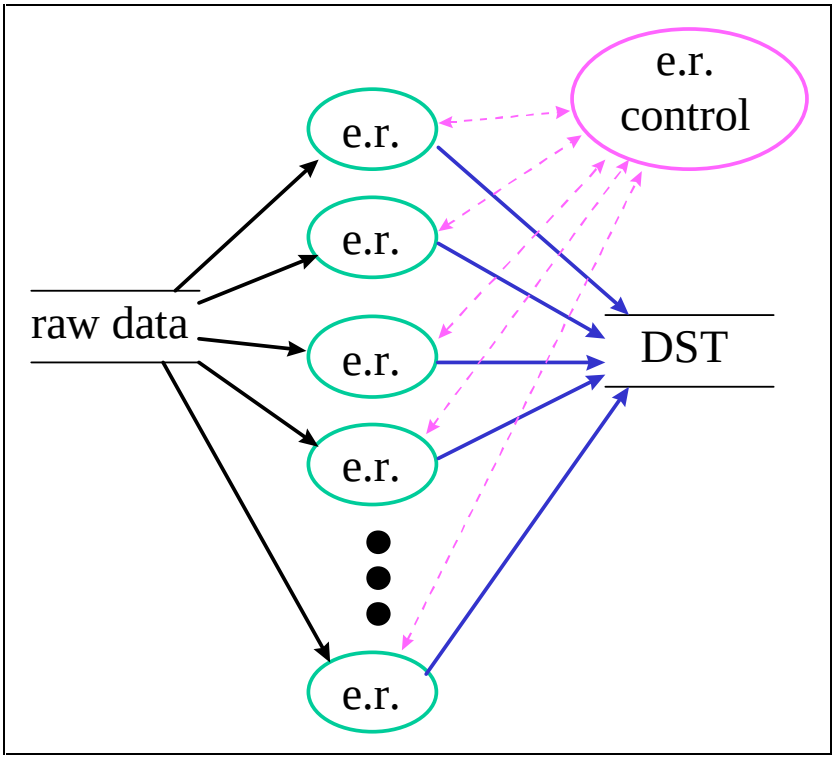

Figure 1. A schematic diagram illustrating the event reconstruction scenario. Events of raw data are read by multiple single-event reconstruction processes (e.r.). The derived data (DST) is written to the output. A controlling processes (e.r. control) coordinates the e.r. processes so that the operate in parallel across separate cpu's and the operate on separate events.

[1] "Off-line Computing at RHIC", Kumar, et al., Yale 40609-1179, http://www.rhic.bnl.gov/export1/docs/html/planning/rococo2/rococo2.html

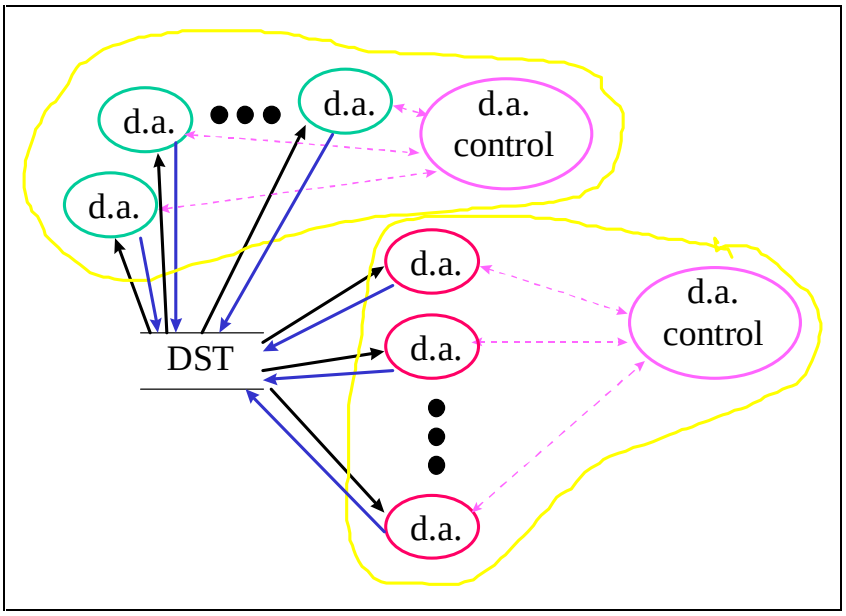

Figure 2. A typical DST analysis scenario is illustrated. Derived event data (DST) is read by a d.a process and further derived event data is written out by the d.a process. Each d.a. process operates on a single event at one time. A set of d.a. processes are controlled by one d.a. control process. The d.a. control process coordinates the set of events which are accessed. A d.a. control process along with it's set of d.a. servers represents a single user of the system. Two simultaneous users are indicated in the figure.